M18002114

Registration No: | | | | | | | | | | |

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M.TECH 2ND SEMESTER REGULAR EXAMINATIONS, MAY 2018
HEAT EXCHANGER ANALYSIS AND DESIGN
Branch: TE, Subject Code:MTEPE2032
Time: 3 Hours
Max Marks : 70

PART-A (10 X 2=20 MARKS)

1. Answer the following questions.

a) Define Fouling Factor and the factors affecting Resistance and heat Transfer? (CO2)
b) What is correction Factor and where it is used? (CO2)
c) Differentiate between Regenerative and Recuperative heat exchanger? (CO1)
d) What is compact Heat exchanger? (CO2)
e) What do you mean by duty of a heat exchanger? (CO3)
f) What is Baffles? Why they are used in a Heat exchanger? (CO3)
g) How can the flow induced vibration be minimized? (CO2)
h) How TEMA charts are are helpful in design of multiple pass heat exchangers? (CO2)
i) Explain the physical significance of NTU. (CO1)
j) In a cross flow both fluids unmixed has water at 60C flowing at 1.25 kg/s. It is to cool 1.2 kg/s of air that is initially at temperature of 50^0C.Calculate NTU & heat capacity ratio. Assume U=130W/m^2K and area is 23m^2. (CO2)

PART-B (5 X 10=50 MARKS)

Answer any five questions from the following.

2. a) Derive the effectiveness of counter flow heat exchanger. What would be the effectiveness of counter flow heat exchanger if Cmin/Cmax =0 and Cmin/Cmax=1? (CO1)[5]

   b) Explain how charts provided by Kays and London are useful in the design of heat exchangers? (CO2) [5]

3. a) Explain flow distribution in heat exchangers mentioning the effect of turbulence, friction factor, pressure loss, orifice, flow nozzle, diffusers, bends, effect of channel divergence and manifolds. (CO4)[5]

   b) Steam enters a counter flow heat exchanger, dry saturated at 10 bar and leaves at 350^0C. The mass flow of stream is 800 kg/min. The gases enter the heat exchanger at 650^0C and mass flow rate is 1350 kg/min. If the tubes are 300 mm diameter and 3 m long, determine the number of tubes required. Neglect the resistance offered by metallic tubes. (CO2)[5]

4. a)Water is required to be preheated for a boiler using flue gases from the boiler stack. The flue gases are available at the rate of 0.25 kg/s at 150°C, with specific heat of 1000 J/kgK. The water entering the exchanger at 15°C at the rate of 0.05kg/s is to be heated to 90°C. The heat exchanger is to be reversed current type with once shell pass and four tube passes. The water flows inside the tubes which are made of copper (25 mm inner and 30 mm outer diameter). The heat transfer coefficient at the gas side is 115 W/m2K while the heat transfer coefficient of the water side is 1150 W/m^2K. A scale on water side offers an additional thermal resistance of 0.02 m^2K/W.

(CO3)[7]

Determine i) overall heat transfer coefficient on the outer tube
ii) Appropriate mean temperature difference
iii) Required tube length
iv) Outer tube temperature and effectiveness if the water flow rate is doubled, giving heat transfer coefficient of 1820 W/m^2K?

b) Draw the temperature variation diagram for Parallel and counter flow heat exchanger with respect to length. (CO1)[3]

5. a) What are the various sources of a noise in a heat exchanger? How it can be minimized inside a heat exchanger? (CO4)[5]
b) In the heat transfer relation $Q=UA\Delta T_{lmtd}$ for a heat exchanger, what is ΔTlm called? Derive the expression for counter flow heat exchanger. (CO1)[5]

6. a) Hot oil is to be cooled by water in a 1-shell-pass and 8-tube-passes heat exchanger. The tubes are thin-walled and are made of copper with an internal diameter of 1.4 cm. The length of each tube pass in the heat exchanger is 5m, and the overall heat transfer coefficient is 310 $W/m^2°C$. Water flows through the tubes at a rate of 0.2 kg/s, and the oil through the shell at a rate of 0.3 kg/s. The water and the oil enter at temperatures of 20°C and 150°C, respectively. Determine the rate of heat transfer in the heat exchanger and the outlet temperatures of the water and the oil. (CO2)[6]
b) With schematic diagram explain the working of 3pass 8 tube type heat exchanger? CO1) [4]

7. a) What do you mean by differential thermal expansion? Write the necessary steps are being taken to avoid this. (CO4)[5]
b) Show with neat sketch of temperature distribution for unmixed cross flow heat exchanger and explain it. (CO4)[5]

8. Write short notes on [5 x 2]
a) Effectiveness & Efficiency of Heat exchanger (CO1)
b) Losses in cooling tower. (CO2)

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